

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 22

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte INTEL CORPORATION

Appeal No. 97-4032
Control No. 90/003,703¹

ON BRIEF

Before KIMLIN, OWENS and WALTZ, *Administrative Patent Judges*.

OWENS, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal from the examiner's final rejection of claims 1-10, which are all of the claims in this reexamination proceeding. Claim 1 is illustrative and reads as follows:

¹ Reexamination proceeding for U.S. Patent No. 4,372,034, issued February 8, 1983, based on Application 06/248,013, filed March 26, 1981. Reexamination request filed January 27, 1995.

Appeal No. 97-4032
Control No. 90/003,703

1. In the fabrication of an integrated circuit, where a substrate is covered with a thermally grown oxide layer and where a substantially thicker deposited oxide layer containing phosphorus is formed over the grown oxide layer, a process for forming an opening and tapered contact through the oxide layers to expose a region in the substrate comprising the steps of:

forming a photoresist layer over said deposited oxide layer with an opening through said photoresist layer over said region;

etching through said phosphorus containing deposited oxide layer with a wet etchant such that a tapered opening is formed through said deposited oxide layer extending to said grown oxide layer;

etching through said grown oxide layer with a plasma etchant in alignment with said opening through said photoresist layer until said substrate is exposed at said region;

removing said photoresist layer; and,

forming an ohmic contact in said tapered opening through said oxide layers;

whereby a tapered contact is formed through said oxide layers.

THE REFERENCES

Seales	3,842,490	Oct. 22, 1974
Ghezso	4,040,893	Aug. 9, 1977
Sugishima et al. (Sugishima)	4,352,724	Oct. 5, 1982
Logan et al. (Logan)	4,367,119	Jan. 4, 1983

THE REJECTIONS

Claim 1 stands rejected under 35 U.S.C. § 103 as being unpatentable over Sugishima and appellant's admitted prior art. Claims 2 and 3 stand rejected under 35 U.S.C. § 103 as being

Appeal No. 97-4032
Control No. 90/003,703

unpatentable over Sugishima, appellant's admitted prior art and Ghezze. Claims 4-8 stand rejected under 35 U.S.C. § 103 as being unpatentable over Sugishima, appellant's admitted prior art, Ghezze and Seales. Claims 9 and 10 stand rejected under 35 U.S.C. § 103 as being unpatentable over Sugishima, appellant's admitted prior art, Ghezze and Logan.²

OPINION

We have carefully considered all of the arguments advanced by appellant and the examiner and agree with the examiner that appellant's claimed invention would have been obvious to one of ordinary skill in the art at the time of appellant's invention over the applied prior art. Accordingly, the aforementioned rejections will be affirmed.

At the outset, we note that appellant states that all of the claims stand or fall together (brief, page 7). We therefore limit our discussion to one claim, namely, claim 1. See 37 CFR § 1.192(c)(7)(1995).

Appellant's invention as recited in claim 1 is a process for

²Appellant considers an issue on appeal to be whether the final rejection was premature (brief, page 4). This is a petitionable issue rather than an appealable issue and therefore is not before us for decision. See *Manual of Pat. Examining Procedure* §§ 706.07(c) and 1002.02(c)(4)(a)(6th ed., Rev. 3, July 1997).

forming a tapered opening and contact through oxide layers on an integrated circuit substrate, wherein the oxide layers are a thermally grown oxide layer on the substrate and a substantially thicker, phosphorous-containing deposited oxide layer over the thermally grown oxide layer. A photoresist layer which has an opening where the opening in the oxide layers is to be made is formed over the deposited oxide layer. A wet etchant is used to etch through the deposited oxide layer so as to form an opening which extends to the thermally grown oxide layer. This opening is larger at the underside of the photoresist layer than the opening in the photoresist layer and tapers in the direction of the thermally grown oxide layer. The thermally grown oxide layer is etched with a plasma etchant to form a relatively straight edged opening which is in alignment with the opening in the photoresist layer and extends to the substrate. The photoresist layer then is removed and a tapered ohmic contact is formed through the openings in the oxide layers.

Sugishima discloses a process for etching through a layer or layers on an integrated circuit substrate by forming a thin film of patterned photoresist over the layer or layers, etching partly through the layer or layers by isotropic etching using the patterned photoresist as a mask, thereby forming openings which

at the underside of the photoresist are larger than the pattern openings in the photoresist and which taper in the direction of the substrate, completing the etching by anisotropic etching through the remainder of the layer or layers in the direction of the depth thereof to produce relatively straight edged openings which are in alignment with the corresponding openings in the mask, and then removing the photoresist (abstract; col. 3, lines 5-16; col. 5, lines 12-13; col. 6, line 61 - col. 7, line 13). The isotropic etching can be wet etching or dry etching, but the anisotropic etching can be achieved only by a dry etching method such as plasma etching (col. 3, lines 13-16; col. 5, line 32 - col. 6, line 47). Sugishima teaches that the method can be used to form via holes (col. 2, lines 38-40).³

Sugishima does not disclose an embodiment in which an integrated circuit substrate has thereon a thermally grown oxide layer over which is a phosphorous-containing deposited oxide layer, the deposited oxide layer is wet etched to form a tapered opening through it and the thermally grown oxide layer is plasma etched until the substrate is exposed. However, appellant acknowledges that it was known in the art to form a phosphorous-

³A discussion of Seales, Ghezzeo and Logan is not necessary to our decision.

containing deposited oxide layer over a thermally grown oxide layer on a substrate and to form openings through the layers to expose underlying substrate regions (col. 1, lines 12-20).⁴

Appellant acknowledges that it was known that if wet etching were used to etch through both layers, the opening in the phosphorous-containing deposited oxide layer would be too large because while the thermally deposited oxide layer was being etched, the much-faster-etching deposited oxide layer would continue to be etched such that a large opening in that layer is formed (col. 1, lines 21-27). Appellant also acknowledges that it was known that if a plasma etchant were used to etch both layers, relatively straight edged openings would be formed in alignment with the overlying openings in the photoresist, and the coverage of a subsequently-applied metal layer at these sharp edges would be thinned, resulting in high current densities in the metal layer at the edges (col. 1, lines 28-35).

Appellant states that in the prior art, as a compromise between using only wet etching and only plasma etching, plasma etching was used to etch through the deposited oxide layer and then wet etching was used to etch through the thermally grown

⁴In the discussion of appellant's invention herein, citations are to the patent under reexamination.

oxide layer (col. 1, lines 38-42). A problem with this approach, appellant points out, is that the openings through the thermally grown oxide layer are relatively large and difficult to control in size, which requires that the underlying substrate regions where contacts are being made must be larger (col. 1, lines 46-51). Appellant's solution to the problem is a compromise between using only wet etching and only plasma etching wherein wet etching is used to form a tapered opening through the deposited oxide layer, thereby avoiding the formation of sharp edges, and then plasma etching is used to form a narrow opening through the thermally grown oxide layer (col. 1, lines 52-55).

Sugishima discloses appellant's approach to solving the problem. That is, to avoid formation of sharp edges, an opening with tapered edges is formed by wet or dry etching (col. 3, lines 5-16; col. 6, line 68 - col. 7, line 3). Then, in order for the opening at the point of contact with the underlying layer to be equal to the opening of the photoresist mask, anisotropic etching such as plasma etching is used to form a narrow opening between the tapered opening and the underlying layer (col. 5, line 62 - col. 6, line 47; col. 6, line 65 - col. 7, line 19). Sugishima teaches that this approach provides for tapered edges which prevent wiring layers from being thin at sharp edges, yet

Appeal No. 97-4032
Control No. 90/003,703

provides densely packed, fine integrated circuit patterns (col. 1, lines 36-55; col. 2, lines 58-62). Sugishima further teaches that the method can be applied to whatever materials can be etched by any known etching technique and to as many layers as required (col. 2, lines 62-66).

In view of this teaching by Sugishima, it would have been *prima facie* obvious to one of ordinary skill in the art to apply this method to the structure which appellant acknowledges was known in the art, i.e., a substrate having thereon a thermally grown oxide layer over which is a phosphorous-containing deposited oxide layer, in order to obtain the benefits disclosed by Sugishima, which are avoidance of a sharp edged opening which would cause thinning of a subsequently-applied metal layer at the edge, and formation of an opening at the point of contact with the substrate which is the same size as the opening in the photoresist mask and which thereby enables a densely packed, fine integrated circuit pattern to be formed (col. 1, lines 36-55; col. 2, lines 58-62).

Even in the absence of appellant's acknowledged prior art, it would have been *prima facie* obvious to one of ordinary skill in the art to apply Sugishima's teaching to a substrate covered with a thermally grown oxide layer over which is a phosphorous-

containing deposited oxide layer. Sugishima discloses an underlying layer having thereon a grown silica layer over which is a layer of Si_3N_4 (col. 6, lines 61-65). There is a tapered opening in the Si_3N_4 layer, and at the point of contact of the grown silica layer with the underlying layer there is an opening which is the size of the opening in a photoresist mask formed over the Si_3N_4 layer (col. 6, line 65 - col. 7, line 3). The openings in the layers are formed by etching the Si_3N_4 layer partly or completely by isotropic etching to form a tapered opening, and then using anisotropic etching to form an opening which has equidistant sides and is equal in size to the opening of the photoresist mask (col. 6, lines 65-68; col. 7, lines 16-19; Fig. 10). The isotropic etching can be wet etching and the anisotropic etching can be plasma etching (col. 5, line 32 - col. 6, line 47). Sugishima teaches that isotropic etching is applicable to both Si_3N_4 and phospho-silicate-glass layers (col. 5, lines 32-62) and that either of these two materials can be used in the method to form the same layer (claim 17). One of ordinary skill in the art therefore would have been motivated to substitute a phospho-silicate-glass insulating layer for the Si_3N_4 insulating layer over the grown silica layer and would have had a reasonable expectation of success in doing so.

Appeal No. 97-4032
Control No. 90/003,703

Accordingly, such a substitution would have been *prima facie* obvious to one of ordinary skill in the art. See *In re Vaeck*, 947 F.2d 488, 493, 20 USPQ2d 1438, 1442 (Fed. Cir. 1991); *In re O'Farrell*, 853 F.2d 894, 902, 7 USPQ2d 1673, 1680 (Fed. Cir. 1988); *In re Longi*, 759 F.2d 887, 892-93, 225 USPQ 645, 648 (Fed. Cir. 1985).

Appellant argues that Sugishima simply teaches that wet etching and dry etching are possible to do, and does not teach or suggest wet etching followed by dry etching (brief, page 15). This argument is not well taken because Sugishima specifically discloses wet etching followed by dry etching (col. 3, lines 5-16).

Appellant argues that it would not have been obvious to one of ordinary skill in the art to make Sugishima's layer which overlies the thermally grown oxide layer substantially thicker than the thermally grown oxide layer (brief, page 13).

Terms in claims are construed in view of the specification and the prosecution history, see *Smithkline Diagnostics Inc. v. Helena Laboratories Corp.*, 859 F.2d 878, 882, 8 USPQ2d 1468, 1471 (Fed. Cir. 1988), *ZMI v. Cardiac Resuscitator Corp.*, 844 F.2d 1576, 1580, 6 USPQ2d 1557, 1560 (Fed. Cir. 1988), as they would be construed by one of ordinary skill in the art. See *Smithkline*

Appeal No. 97-4032
Control No. 90/003,703

Diagnostics Inc. v. Helena Laboratories Corp., 859 F.2d at 882, 8 USPQ2d at 1471; *Fromson v. Advance Offset Plate, Inc.*, 720 F.2d 1565, 1571, 219 USPQ 1137, 1142 (Fed. Cir. 1983).

The limitation "substantially thicker" was added to the preamble of appellant's claim 1 during the prosecution of the application for the patent under reexamination (amendment filed August 26, 1982). Appellant's only comment regarding this amendment was the following (page 4, amendment filed August 26, 1982):

Moreover, all the claims now indicate that the deposited oxide layer is substantially thicker than the thermally grown oxide layer. This limitation better sets the structure in which the invented process operates.

The examiner then issued a notice of allowability, mailed on November 10, 1982, wherein the only statement regarding why the claims were allowed was the following (page 2):

The following is an Examiner's Statement of Reasons for Allowance: The use of a "substantially thicker" deposited oxide layer with formation of a tapered contact is not found in the prior art.

Appellant's specification does not define the term "substantially thicker", but states (col. 3, lines 7-12):

A thermally grown oxide layer **14** is formed on the substrate **10**; this layer is approximately 1500A-2000A thick in the currently employed and preferred process. A chemical vapor deposited, silicon dioxide layer **16** is

formed over the layer **14**; this layer is approximately 1 micron thick.

In view of this disclosure, we interpret the term "substantially thicker" as meaning thicker by a factor of at least about 5 (i.e., 1 micron[i.e., 10,000Å]/2,000Å).

Appellant acknowledges that in the prior art structure in which a substrate has thereon a thermally grown oxide layer over which is a phosphorous-containing deposited oxide layer, it was known that wet etching etched the deposited oxide layer much faster than the thermally grown oxide layer (col. 1, lines 21-27). Accordingly, when applying the Sugishima method to this structure, one of ordinary skill in the art would have expected that only a very thin thermally grown layer would be needed since, during the wet etching step, little of this layer would be etched away. Furthermore, in view of the teaching by Sugishima that the upper layer is tapered (col. 6, line 68 - col. 3, line 3), one of ordinary skill in the art would have been motivated to make this layer sufficiently thick to provide for the taper. For these two reasons, it would have been *prima facie* obvious to one of ordinary skill in the art to use a deposited oxide layer which is substantially thicker than the thermally grown oxide layer.

Even if appellant's prior art is not relied upon, it would

have been *prima facie* obvious to one of ordinary skill in the art in view of the teaching by Sugishima to form a structure having on a substrate a thermally grown oxide layer over which is a substantially thicker phosphorous-containing deposited oxide layer. Sugishima discloses an embodiment in which an Si_3N_4 layer is formed over a grown silica layer on an underlying layer (col. 6, line 61 - col. 7, line 19), and indicates that the method is applicable to insulating layers of materials other than Si_3N_4 , such as phosphorous-containing glass (col. 6, lines 49-57; claim 17). Sugishima further teaches that when two layers are isotropically etched, the etching rate of the upper layer must be larger than that of the lower layer (col. 7, lines 19-24). In view of this teaching, one of ordinary skill in the art would have been motivated to use either Si_3N_4 or any other insulating material disclosed by Sugishima which is determined through no more than routine experimentation to have a high wet etch rate relative to the grown silica layer, such as phosphorous-containing glass, and to use a relatively thin layer of grown silica since little of the layer would be removed during the wet etching. Sugishima further teaches that the upper layer is to be tapered (col. 6, line 68 - col. 7, line 3). In view of this teaching, one of ordinary skill in the art would have been

Appeal No. 97-4032
Control No. 90/003,703

motivated to form an upper deposited layer which is relatively thick so that it can provide the desired taper.

Appellant argues that the issue of whether it would have been obvious to one of ordinary skill in the art in view of appellant's acknowledged prior art to use a deposited oxide layer which is substantially thicker than the thermally grown oxide layer was decided during the prosecution of the application for the patent under reexamination and therefore, according to the decision in *In re Recreative Technologies Corp.*, 83 F.3d 1394, 38 USPQ2d 1776 (Fed. Cir. 1996), cannot be addressed during this reexamination proceeding (brief, pages 9-11).

We are not persuaded by appellant's argument due to factual differences between the present case and both *Recreative Technologies* relied upon by appellant and the more recent case on point, *In re Portola Packaging Inc.*, 110 F.3d 786, 42 USPQ2d 1295 (Fed. Cir. 1997).

In *Recreative Technologies*, the same reference to Ota was relied upon under 35 U.S.C. § 103 by the examiner in both the original examination and the reexamination proceeding. See *Recreative Technologies*, 83 F.3d at 1395, 38 USPQ2d at 1777. In the appeal of the examiner's rejection in the reexamination proceeding, the board reversed the examiner's rejection but

Appeal No. 97-4032
Control No. 90/003,703

relied upon this same reference under 35 U.S.C. § 102. *See id.* at 1396, 38 USPQ2d at 1777. The court stated that "[t]he question of patentability in view of the Ota reference was decided in the original examination, and thus it can not be a substantial new question." *Id.* at 1398, 38 USPQ2d at 1779.

In *Portola Packaging*, during the original examination the examiner's rejections included a rejection over Hunter under 35 U.S.C. § 102 and a rejection over the combined teachings of Faulstich and two other references under 35 U.S.C. § 103. *See Portola Packaging*, 110 F.3d at 787, 42 USPQ2d at 1296. During the reexamination proceeding, the board affirmed a rejection by the examiner under 35 U.S.C. § 103 over the combined teachings of Faulstich and Hunter. *See id.* The court stated that "we hold that a rejection made during reexamination does not raise a substantial new question of patentability if it is supported only by prior art previously considered by the PTO in relation to the same or broader claims." *Id.* at 791, 42 USPQ2d at 1300.

In the present case, the rejection is based on Sugishima, which was not before the examiner in the original examination, in view of appellant's acknowledged prior art, and therefore is not supported only by prior art previously considered by the examiner. Thus, reliance upon the combined teachings of

Appeal No. 97-4032
Control No. 90/003,703

Sugishima and appellant's acknowledged prior art is not barred by the decision in either *Recreative Technologies* or *Portola Packaging*.

Appellant expresses an understanding that Fig. 10 is the embodiment of Sugishima relied upon by the examiner and argues that there are differences between that figure and appellant's claimed invention (brief, pages 15-16). This argument is not well taken because all disclosures in a reference must be evaluated for what they would have fairly suggested to one of ordinary skill in the art. See *In re Boe*, 355 F.2d 961, 965, 148 USPQ 507, 510 (CCPA 1966). The inquiry under 35 U.S.C. § 103 is not merely what references expressly teach, but what inferences one of ordinary skill in the art reasonably would draw from them. See *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976); *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968).

After considering the teachings of Sugishima as a whole, as discussed above, alone or in combination with appellant's acknowledged prior art, along with the arguments of appellant and the examiner, we conclude that appellant's claimed invention would have been obvious to one of ordinary skill in the art within the meaning of 35 U.S.C. § 103.

Appeal No. 97-4032
Control No. 90/003,703

DECISION

The rejections under 35 U.S.C. § 103 of claim 1 as being unpatentable over Sugishima and appellant's admitted prior art, of claims 2 and 3 as being unpatentable over Sugishima, appellant's admitted prior art and Ghezze, of claims 4-8 as being unpatentable over Sugishima, appellant's admitted prior art, Ghezze and Seales, and of claims 9 and 10 as being unpatentable over Sugishima, appellant's admitted prior art, Ghezze and Logan, are affirmed.

Further proceedings in this case may be taken in accordance with 35 U.S.C. § 141 to § 145 and § 306, and 37 CFR § 1.301 to § 1.304. Note also 37 CFR § 1.197(b). If the patent owner fails to continue prosecution, the reexamination proceeding will be terminated, and a certificate under 35 U.S.C. § 307 and

Appeal No. 97-4032
Control No. 90/003,703

37 CFR § 1.570 will be issued canceling the patent claims, the rejection of which has been affirmed.

AFFIRMED

EDWARD C. KIMLIN)	
Administrative Patent Judge)	
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TERRY J. OWENS)	BOARD OF PATENT
Administrative Patent Judge)	APPEALS AND
)	INTERFERENCES
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Appeal No. 97-4032
Control No. 90/003,703

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